

AIR WAR COLLEGE

RESEARCH REPORT

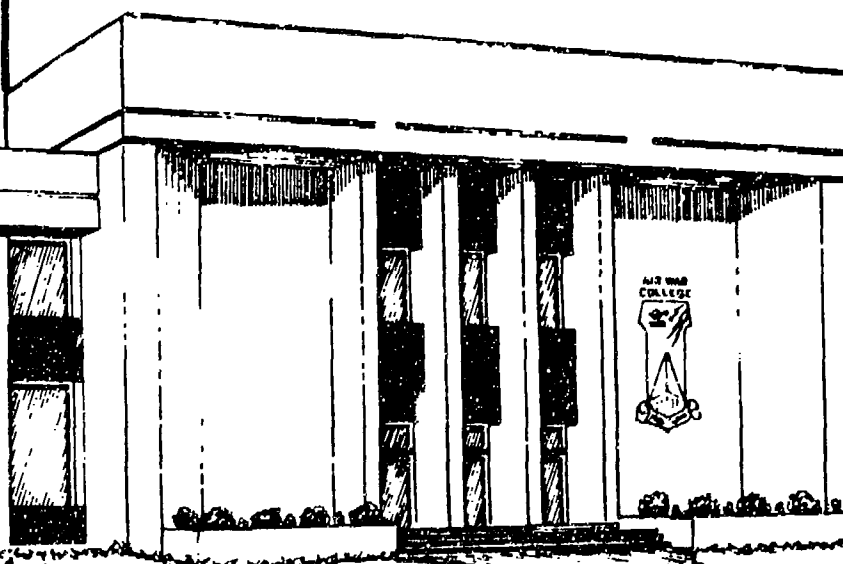
No. AU-ANC-88-217

DTIC
SELECTED
JAN 12 1989
S D

AD-A202 701

USAF AIRCRAFT MAINTENANCE ORGANIZATIONAL
STRUCTURE: WHERE WE'VE BEEN, WHERE WE ARE,
WHAT'S THE FUTURE

By LIEUTENANT COLONEL THOMAS E. REITER



89 1 09 309

AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

APPROVED FOR PUBLIC
RELEASE; DISTRIBUTION
UNLIMITED

AIR WAR COLLEGE
AIR UNIVERSITY

USAF AIRCRAFT MAINTENANCE ORGANIZATIONAL STRUCTURE
Where We've Been, Where We Are, What's The Future

by

Thomas E. Reiter
Lieutenant Colonel, USAF

A RESEARCH REPORT SUBMITTED TO THE FACULTY
IN
FULFILLMENT OF THE RESEARCH
REQUIREMENT

Research Advisor: Colonel Richard A. Steeves

MAXWELL AIR FORCE BASE, ALABAMA

April 1988

Accession For	
NTIS CRA&I DTIC TAB Unannounced Justification	
By	
Distribution/	
Availability Co	
Dist	Avail and/ Special
A-1	



TABLE OF CONTENTS

CHAPTER		PAGE
	DISCLAIMER.	ii
	ABSTRACT.	iii
	BIOGRAPHICAL SKETCH	iv
I	INTRODUCTION.	1
II	WHERE WE WERE	4
III	WHERE WE ARE.	25
IV	WHAT'S THE FUTURE	33
	NOTES	38
	BIBLIOGRAPHY.	41

DISCLAIMER

This research report represents the views of the author and does not necessarily reflect the official position of the Air War College or the Department of the Air Force. In accordance with Air Force Regulation 110-8, it is not copyrighted, but is the property of the United States Government.

Loan copies of this document may be obtained through the interlibrary loan desk of Air University Library, Maxwell Air Force Base, Alabama 35112-5564 (telephone: [205] 293-7223 or AUTOVON 875-7223).

AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: USAF Aircraft Maintenance Organizational Structure
Where We've Been, Where We Are, What's The Future

AUTHOR: Thomas E. Reiter, Lieutenant Colonel, USAF

→ An analysis of the various organizational structures used to support aircraft maintenance in the Air Force. The author examines the evolution of the different concepts used in the three primary flying major commands; MAC, SAC and TAC; beginning in 1947, just prior to the Air Force becoming a separate service. The evolutionary analysis reveals that the Air Force alternated several times between a centralized and decentralized maintenance concept before arriving at the present situation. Currently, each major command has developed a maintenance organizational concept uniquely tailored to its particular mission. The author concludes that this is the most effective way to manage and organize USAF aircraft maintenance organizations and no attempt should be made to standardize concepts Air Force wide. The paper concludes with a discussion of how three future events may effect aircraft maintenance organizational concepts. Those three events are consolidation of maintenance AFSCs, budgetary constraints, and reliability and maintainability initiatives. (S) [unclear]

BIOGRAPHICAL SKETCH

Lieutenant Colonel (Colonel select) Thomas E. Reiter (M.P.A., Golden Gate University) was commissioned upon graduation from Florida State University in 1967. He earned his navigator wings and flew over 4,400 hours in various aircraft until entering the logistics career field in 1980. He became interested in aircraft maintenance organizational structure while working as the Director of Logistics Readiness at Headquarters, Aerospace Rescue and Recovery Service in 1980. He subsequently served as an organizational maintenance squadron commander and a director of maintenance engineering at numbered air force level. He has been directly involved in changing organizational structures of several maintenance organizations. Lieutenant Colonel Reiter is a graduate of the Air War College, class of 1988.

CHAPTER I

INTRODUCTION

Air Force aircraft maintenance organizations today appear, on the surface, to be organized in a hodge-podge manner. The variety of terms used to describe various concepts of organization; on-equipment, off-equipment, centralized, decentralized, production oriented maintenance organization (FOMO), combat oriented maintenance organization (COMO), readiness oriented logistics system (ROLS); would certainly strike fear into the heart of any maintainer from the 1950's era. For that matter, many maintenance people in today's Air Force might have difficulty explaining any organizational structure other than their own unit's.

Each of the three primary flying mission areas; fighters, bombers and airlifters; use different concepts of organizational structure for their aircraft maintenance units. The fighter or Tactical Air Forces (TAF) world, including Tactical Air Command (TAC), United States Air Forces Europe (USAFE) and Pacific Air Forces (PACAF), are organized under a decentralized maintenance concept in a COMO. The Strategic Air Command (SAC) has recently converted to a decentralized concept called ROLS to support the strategic bomber and tanker forces. The Military Airlift Command (MAC) has remained with the traditional

centralized concept of maintenance management that has been standard in the Air Force since 1958.

Each of the three organizational structures currently in use is dramatically different from the way maintenance was organized during World War II and when the Air Force became a separate service in 1947. The evolution of these various concepts is an interesting and revealing story. That, in part, is what this paper is about. The evolution of different organizational structures strictly along MAJCOM lines is a curious development in an Air Force that stresses standardization. That process will be examined in detail to compare the rationale for going with each particular concept.

After looking at 40 years of history, the focus will turn to an examination of the current organizational concepts used in TAF, SAC and MAC. Each will be discussed in terms of their advantages, disadvantages, efficiency and effectiveness. I recognize that there are other MAJCOMs that fly and maintain aircraft, but since the vast majority of flight activity happens in the three basic mission areas discussed earlier, this paper will address only those three. In addition, the primary focus will be on wing level operational flying organizations since that is the basic flying unit in the Air Force. The basic question to be addressed is "Are we organized the right way for the right reasons?"

The paper will conclude with a look at what might be appropriate for the future. Should the Air Force continue with the current pattern of allowing each MAJCOM to unilaterally develop maintenance organizational structures or would it be appropriate to standardize concepts Air Force wide?

CHAPTER II

WHERE WE'VE BEEN

Even before the Air Force was formally established as a separate service in September, 1947, the aircraft maintenance organizational structure was already changing from the way it was organized in World War II. Two significant things happened in 1947 that would begin the evolution of the aircraft maintenance concepts we see today. Those two events were the revision of AAF Regulation 65-1 and adoption of the wing/base organizational pattern.

The revision to AAF Regulation 65-1, Supply and Maintenance Program of the AAF, marked the first appearance of the terms organizational maintenance, field maintenance and depot maintenance, terms still in use today.¹ Prior to this change, maintenance had been organized into four echelons. First echelon maintenance consisted of servicing, preflight and daily inspections, and minor repairs. Second echelon maintenance included periodic inspections and such major repair and replacements, engine changes for example, that could be accomplished at unit level with hand tools and mobile equipment. Third echelon maintenance required large shop equipment and specialized mechanics. Fourth echelon maintenance consisted of major overhaul or modification and was normally accomplished at a central industrial facility.²

It would be a mistake to suggest that this change in nomenclature was significant in and of itself. In fact, on the flight line virtually nothing changed because the functional organizational structure was unaffected. First and second echelon maintenance had simply been combined and renamed organizational maintenance. Organizational maintenance was performed under the generalist crew chief concept and belonged to the operational squadron commander.³ Third echelon maintenance was renamed field maintenance and was still the responsibility of sub-depots belonging to the Air Service Command.⁴ The decentralized maintenance concept was still very much intact. This change to AAF Regulation 65-1 signaled the first of several fundamental changes that were to occur in the next few years that would irrevocably shape Air Force maintenance.

The second event in 1947 to have a far reaching impact on maintenance organizational structure was the adoption of the wing/base organizational pattern to replace the World War II combined combat and service group. The intent was to provide unity of command and to make the best use of what was a diminishing post-war personnel pool. The wing consisted of four groups under the control of a single wing commander. The four groups were the combat group, maintenance and supply (M&S) group, air base group and the medical group.⁵ Organizational maintenance remained in the combat group under the operational flying squadron commander

but field maintenance was now placed under M&S as an integral part of the wing. Although there was not a conscious effort to do so at the time, this had the effect of taking the first step toward a centralized maintenance organization because it was the first time organizational and field maintenance were in the same unit. This was the situation on September 18, 1947 when the Air Force became a separate service.

Keep in mind that although the Army Air Force had experimented with a specialized maintenance concept toward and after the end of the war, the crew chief concept was still the primary maintenance method. It was based on, as the name implies, the crew chief. He alone managed all work done on his aircraft and supervised a team of mechanics who worked on only one aircraft in a classic decentralized maintenance concept. He had a great deal of knowledge of all aircraft systems and only occasionally had to request assistance from the field maintenance (third echelon) organization. When he did request assistance, those augmentees worked under his supervision while they were on his aircraft. This system was effective because the crew chiefs were very senior and experienced noncommissioned officers (NCOs) who stayed in the service after the war and because of the relative simplicity of aircraft and systems.⁶

A significant historical event which occurred less than a year after the Air Force came into being would change

Air Force aircraft maintenance organizational structure from then on. The Berlin Airlift began on 26 June 1948 and continued until 12 May 1949.⁷ In addition to the obvious political significance of the operation, it provided extremely valuable training for maintenance personnel and put some of the old concepts to the test.

The Commander of United States Air Force in Europe at the time was a man who would have greater impact on aircraft maintenance in the Air Force for the next 25 years than anyone else. He was Lt General Curtis E. LeMay. He determined that the only way to meet the requirement with the limited number of airlift aircraft available was to go to a round-the-clock flying operation, which of course required a round -the-clock maintenance operation. The crew chief system simply could not be adapted to that type operation since there were finite limitations on how long any one individual could work. "The only system of aircraft maintenance which could fill the requirements was the specialized maintenance system. Thus, specialized aircraft maintenance was born out of necessity to support the Berlin Airlift."⁸

In October, 1948, LeMay, who was then a four star general, became Commander of the Strategic Air Command.⁹ His influence was seen shortly thereafter when SAC adopted the specialized maintenance system in August, 1949. Along with the change in concept from the crew chief system to the

specialized system came a needed change in organizational structure. This marked the first formal move toward centralized maintenance in the Air Force.

The implementing directive was SAC Regulation 66-12, Maintenance Management, and its purpose was to "establish a functional aircraft maintenance organization within the wing-base organization which would insure full utilization of personnel and facilities to produce maximum availability of aircraft."¹⁰ It disbanded the M&S group and created three maintenance production squadrons that were supervised by a Director of Maintenance on the wing staff. The three squadrons were the Field Maintenance Squadron (FMS), Periodic Maintenance Squadron (PMS) and Electronic Maintenance Squadron (EMS). The organizational maintenance capability was retained in the operational flying squadron in the Combat Group.¹¹ Centralized control was provided through a Maintenance Control function of the wing staff.

Various commands were experimenting with different maintenance organizational structures during the same time period. Shortages of skilled personnel, fewer but more complex aircraft, and a constant need to reduce out-of-commission time drove many new and innovative ideas. Air Training Command had expanded on SAC's concept of specialized maintenance and developed a system that looked remarkably similar to the centralized maintenance concept that would eventually evolve Air Force wide in the late

1950s. ATC even removed organizational maintenance from the operational flying squadron and placed it in the M&S Group under a chief of maintenance. Military Air Transport Service (MATS) was using a variation of specialized maintenance and HQ USAF seemed content to allow each MAJCOM to experiment with different concepts. It was clear, however, that the Air Force was moving slowly, inexorably toward a centralized, specialized, functionally commanded maintenance organizational structure.¹²

By 1953, the USAF Inspector General began to question whether the montage of different maintenance organizational concepts were serving the best interests of the Air Force. In his semi-annual report to the Chief of Staff he pointed out:

As a result of over one hundred (100) inspections, both readiness and technical, conducted by this office, it was determined that no universally effective specialized and standardized system of aircraft maintenance existed in the United States Air Force. The one notable exception was the Strategic Air Command, which has made a concerted effort to achieve a modern concept of maintenance and was experiencing excellent results in the conservation of technical skills, tools, facilities and materials. Other Commands, however, were employing various methods and systems of aircraft maintenance largely at the discretion of local commanders and maintenance officers.¹³

The Inspector General's observations did not attempt to quantify what detrimental effects these seemingly haphazard and nonstandard approaches were having on aircraft availability, but it wasn't long before the Air Staff was searching for a solution. I have a strong suspicion, based

on the Inspector General's comments, that General LeMay strongly influence what happened next.

In December, 1953 the first Air Force Regulation (AFR) dealing with maintenance management was written since AAF Regulation 65-1 was published in 1947. It was AFR 66-1, Maintenance-Engineering. Its purpose was to "provide guidance for Air Force personnel in order that they may plan and execute their maintenance responsibilities."¹⁴ Although AFR 66-1 was only four pages long, it was a first attempt to institutionalize some of the concepts that had taken hold since 1947. It defined the three levels of maintenance; organizational, field and depot; and, perhaps more significantly, subtly acknowledged the current lack of guidance on organizational structure. It temporarily gave the MAJCOMs authority to tailor maintenance organizations to suit their mission and type of aircraft, something they had done all along anyway. However, it left the door open by stating:

Frequent re-examination of the Air Force maintenance structure will be made to assure that organizations, facilities, equipment, and specialists are available and fully able to meet the support requirements of newly introduced items of equipment or weapon systems.¹⁵

It didn't take long for that re-examination to begin. In early 1955, the Air Staff initiated a study at Dover AFB, Delaware at a large MATS flying wing. It was conducted by a USAF Management Engineering Team and resulted in some radical proposals, at least for that time. It was

the first time, other than in isolated cases in ATC, that there was a formal proposal to remove organizational maintenance from the operational flying squadron and consolidate it with field maintenance under a wing chief of maintenance.¹⁶

After almost nine years as a service, the Air Force published its first definitive guidance on maintenance organizational structure on 1 September 1956. That guidance took the form of AFM 66-1, Maintenance Management Policy. Care should be taken not to confuse AFM 66-1 with AFR 66-1 that was initially published in 1953 and was in its second revision by 1956. AFM 66-1 was patterned after SAC Regulation 66-12 and incorporated the basic guidelines of AFR 66-1.

The structure laid out by the new manual established the position of a chief of maintenance who reported directly to the wing commander. Three squadrons worked directly for, and reported to, the chief of maintenance. They were the Organizational Maintenance Squadron (OMS), Field Maintenance Squadron (FMS) and Electronics Maintenance Squadron (EMS). The chief of maintenance also had a staff to help him centrally control all maintenance activity in the wing.¹⁷ The old one-man crew chief who did it all system was gone forever.

This new organizational structure began a new era in

Air Force aircraft maintenance and was designed to increase aircraft availability and have three primary benefits.

First, a standardized system was set up for all major commands in the Air Force. Second, specific goals were set for the maintenance organization. Aircraft in-commission rates, component repair standards, and aircraft scheduling objectives were among them. Third, man-hour accounting and maintenance data collection was instituted.¹⁸

There was just one catch -- AFM 66-1 was implemented as a MAJCOM option and this first edition of the manual met with numerous objections and, other than in SAC, only perfunctory compliance. Operational flying squadron commanders were leery and suspicious of this new and yet unproven system.¹⁹

The idea of a centralized maintenance organization, standardized Air Force wide, had strong support from the Chief of Staff, General Thomas D. White, and on 1 July 1958, a revised version of AFM 66-1 was published and implementation was mandatory for all USAF organizations.

General White said:

I consider it imperative for the Air Force to install uniform and standard maintenance procedures such as represented by AFM 66-1 at the earliest possible date ... This objective can only be reached through aggressive and dedicated participation by all units of the Air Force in this program.²⁰

In a nutshell, the new structure was designed to provide centralized control at the chief of maintenance level with decentralized execution at the maintenance squadron level and to organize and command maintenance in a functional way. It was still unit level maintenance, except

that the "unit" was now a wing instead of a squadron. The 5 September 1961 revision to AFR 66-1, now newly titled Depot, Field, and Organizational Maintenance, clearly defined the objective:

Organizational structures must be:

- 1) Designed around a wartime operational concept to assure an in-being maintenance capability adequate to effectively support requirements of both limited and general war situations.
- 2) Responsive to centralized control and management.²¹

The decade of the 60's initially saw acceptance of centralized maintenance and, with the normal tweaking of any new concept, consolidation of its gains. It wasn't long, however, before the system that took almost 15 years to develop and implement would be severely tested, particularly in TAC.

A typical tactical fighter wing in TAC was organized with three operational flying squadrons under a Deputy Commander for Operations (DO) and the three AFM 66-1 maintenance squadrons, OMS, FMS and EMS, under a Deputy Commander for Maintenance (DCM). The maintenance organizational structure seemed to work well at home station, but when one of the flying squadrons deployed, which was a common occurrence during that period, it pointed out what appeared to be a basic flaw. Maintenance was organized under a specialized concept at the wing level and operation's basic deployable unit was a squadron. Peacetime

austere manning would not allow the total maintenance manpower pool to be divided up between the three flying squadrons because the resultant number could not support the maintenance requirements of an entire squadron.

The maintenance organizational structure had been designed for efficiency, and the economies of scale allowed the whole to be greater than the sum of the parts. The result was that the small maintenance contingent that augmented the flying squadrons on deployments found themselves working 14-16 hour days and still not generating an adequate number of sorties.²² The organization was efficient, but not effective. Historically, in the face of such dilemmas, the Air Force opted for one of two options -- increase manpower or reorganize. In this instance, circumstances allowed for both options.

Between 1960 and 1966 the Air Force saw a personnel increase of 8.8 percent (over 72,000 personnel).²³ Most of these were necessary to support the expanding conflict in Vietnam. Initially, many fighter units were deployed to Vietnam on a TDY basis, but soon "TDY manning became PCS, and the manpower situation improved, and HQ USAF placed flight line maintenance back into the tactical squadrons under operations."²⁴ In addition, specialist support, supply support, and munitions load teams, and a small maintenance control were incorporated into the tactical flying squadrons. These events must have certainly been a

shock to a maintenance community that had finally adapted to being functionally organized. To complicate matters, PACAF Regulation 66-12 had been written to formalize the "new" structure which looked remarkably similar to pre-AFM 66-1 maintenance organizational structures.

The PACAF alignment had the OMS maintenance officer administratively assigned to the flying squadron and reporting to the chief of maintenance who worked for the wing commander. This created two problems. First, the tactical squadrons were required to perform aircraft phase inspections which were, by necessity, scheduled by the chief of maintenance. Second, the maintenance people were rated by the flying squadron commander even though they functionally worked for the chief of maintenance.²⁵ The end result was, in effect, a return to decentralized maintenance for tactical units in Southeast Asia.

Meanwhile in the continental United States (CONUS), TAC initiated a similar concept in 1966 called "TAC Enhancement which was designed to meet mobility requirements. The idea was to reorganize tactical forces into an interim decentralized structure with the squadron as the basic operational unit. It was virtually an exact replica of the PACAF structure based on the concept that the units should operate exactly the same at home station as they do when deployed. Manpower resources were still plentiful so providing personnel was not a problem. HQ TAC

described the program as follows:

We envisage that this interim reorganization will enhance the efficiency of maintenance functions within deployed and dispersed units . . . from the moment they deploy. Continuity of supervision will not be interrupted. Squadrons will be better able to cope with the unavoidable problems of dislocation. Overall, decentralization will improve the capability of TAC's fighter and reconnaissance squadrons to continue their worldwide missions.²⁶

The tactical fighter community that had shown the most resistance to converting to centralized maintenance all through the fifties had succeeded in less than eight years in returning to decentralized maintenance. It is also interesting to note that TAC took this action just a little more than a year after General LeMay retired as the USAF Chief of Staff in January 1965. General LeMay was known for his strong support of the centralized maintenance concept. TAC's maintenance organizational structure was to remain decentralized until 1972.

As the Vietnam war was coming to an end, consolidation and economy again became the order of the day. The USAF could no longer afford the manpower costs caused by duplication of effort inherent in TAC's decentralized maintenance concept.²⁷ By 1972, Air Force personnel strength had dropped to its lowest since 1950, an 18 percent reduction just since 1966.²⁸ There was no question that TAC's decentralized structure enhanced mobility by having each flying squadron self-sufficient in terms of organizational maintenance. Aircrews and

maintenance were closely associated with each other and could take advantage of the benefits of such a relationship at home station and deployed. There were drawbacks, however. Training was a problem because a mechanic transferred either to or from TAC had to be retrained on the standard AFM 66-1 maintenance system and couldn't become fully productive until he learned the management system of the new command. "Under these circumstances, standardization can become cost effective. Therefore, the decision has been made to reorganize USAF to a standardized and centralized system of maintenance management."²⁹ On 1 July 1972, TAC did indeed convert back to the Air Force standard centralized maintenance system under AFM 66-1.

On 1 August 1972, the Air Force published a major revision to AFM 66-1 that greatly expanded the guidance in the previous version of the manual. The new manual consisted of 10 volumes that covered every detail of Air Force maintenance including aircraft, missiles, and communications equipment. It again standardized Air Force wide the centralized maintenance concept and cautioned each wing commander to "make every effort to make equipment available for maintenance when the resources are available."³⁰ This was a significant philosophical change because in the past maintenance was performed whenever the aircraft were not on the flying schedule and the new policy basically called for the aircraft to be on the flying

schedule whenever they were not required to be in maintenance. As a matter of fact, in an unprecedented forward written to the new AFM 66-1, the USAF Chief of Staff Gen John D. Ryan said:

Economy in the use of resources can only be achieved by balancing operational requirements and maintenance capability. This requires planning and comprehensive scheduling of equipment maintenance. Management effectiveness can then be measured in terms of maintenance accomplishments.⁵¹

The message to wing commanders was clear. Maintenance was to receive equal priority with operations in the planning and scheduling process. This marked the first time that such definitive guidance had been given from such a high level and this far-sighted approach would go a long toward increasing aircraft availability in real terms. Day-to-day maintenance was no longer the responsibility of the operational flying squadron, but put in the hands of professional maintainers to work on an equal basis with operations to accomplish a common objective. That objective was set and monitored by one central authority, the wing commander.

Standardization was the theme of the new AFM 66-1. Strict adherence to a rigid program of reporting was the key to documenting maintenance actions. The manual went into great detail and left very little to the individual's imagination or judgement. MAJCOM evaluation teams were established to insure compliance with standard maintenance

practices and technical data. After years of flexibility in the area of maintenance organizational structure, this manual seemed like a final effort to once and for all standardize the Air Force maintenance structure and to discourage further innovation. In only a few short years, however, dramatic change would again be the norm, and it would again be initiated in TAC.

In 1976, the new Chief of Staff, Gen David C. Jones, established the Maintenance Posture Improvement Program (MPIP) to "find new ways of going about the complicated business of maintenance which would permit more efficient and effective use of the total Air Force maintenance resources."³² TAC was still wrestling with the problem of how to achieve the increased readiness and sortie production/surge capability the Air Force required with a maintenance structure that was not conducive to that goal. Deployments constantly thinned out the maintenance capability and people were working long hours just to keep from falling farther behind. SAC and MAC were well served by the AFM 66-1 centralized concept because their missions were not sortie intensive, nor did they involve unit deployments for extended periods of time. TAC was desperate for a system that would fit their unique requirements. Air Force personnel levels had dropped another 20 percent below 1972 levels so any concept that required manning increases was out of the question. As part of the MPIP, TAC developed

and tested a new base level maintenance organization called the Production Oriented Maintenance Organization (POMO).³³

Unlike many of the previous TAC reorganization proposals, POMO was neither an attempt to put maintenance back in the operational flying squadrons or to increase maintenance manning. It was, in fact, an attempt to get TAC off what was to become known as the "slippery slope."³⁴

TAC found itself caught in a situation where the requirement for sortie production was steadily increasing and the maintenance capability to produce sorties was constant. This created the "slippery slope" effect and because of it TAC was in a classic "you can't get there from here" situation.

As the HQ USAF Director of Maintenance Engineering and Supply, Maj Gen William R. Nelson, put it:

Given the constraints in people and dollars we are faced with, there is a limit to how much running faster, jumping higher and sweating more we can do without some major changes in the way we go about our business.³⁵

Those major changes were born out of some lessons the USAF learned from the Israeli Air Force (IAF) during the 1973 war. The IAF was able to generate some remarkably high sortie rates by cross utilizing skills of available personnel. Avionics technicians had been trained to refuel aircraft and other traditional specialists were used to tow and arm aircraft and even to change tires.³⁶ This concept became a force multiplier that TAC felt could be used to

expand their sortie production with no increase in personnel.

Since the key to FOMO was the efficient use of specialists, they were divided into two groups based on the type of work they did. Under AFM 66-1, avionics specialists were all assigned to the Avionics Maintenance Squadron (AMS). During any given shift, a certain number of people from each avionics shop, such as radar, instrument, or doppler, were assigned to the Specialist Dispatch section. When a call came from Job Control that a particular aircraft needed a certain specialist, that specialist would proceed to the flight line and troubleshoot the problem, often removing the suspect component and bringing it back to the shop for repair. Meanwhile, the aircraft sat out of commission. If there was no shop work for a particular specialist, and no requirement to respond to a dispatch call from Job Control, they just waited for something to do. Meanwhile, their crew chief counterparts on the flight line were always swamped with work. This situation led to a decision under FOMO to divide maintenance by where the work was accomplished, either on-equipment or off-equipment, instead of functionally by who performed it, either crew chief or specialist.

Using this philosophy, specialists from AMS, FMS and MMS were reassigned directly to the flight line and placed in the same squadron as the aircraft generalist crew chiefs

(AFGs). The resulting squadron, renamed the Aircraft Generation Squadron (AGS) vice OMS, was now able to handle all on-equipment maintenance. The specialists remaining in the old AMS, FMS and MMS were grouped into two squadrons called the Equipment Maintenance Squadron (EMS) and Component Repair Squadron (CRS). EMS and CRS were responsible for all off-equipment maintenance.

The advantages of this organizational structure were threefold:

First, it gets the on-equipment people closer to the job and reduces the built-in delays of the AFM 66-1 specialist dispatch system. Second, by placing the people on the flight line that you need to turn aircraft the sortie production and surge capability of the unit is enhanced. Finally, we believe it returns a lot of the decision making authority--which has been eroded over the years--to junior officers and senior NCOs on the flight line to get the job done.³⁷

Because the overall pool of specialists had been split into two separate groups, on and off-equipment, economy of force considerations required that each group be increased slightly in number. That increase was offset by a decrease in the number of AFGs. The key to this zero sum gain in manpower was Cross Utilization Training or CUT. The specialists in AGS were CUT trained to accomplish some AFG duties such as refueling, towing, jacking, washing and marshalling.³⁸

After an extensive and successful test program, POMO was implemented TAC wide and a new AFR 66-5, Production Oriented Maintenance Organization (POMO), was published on

17 October 1977. SAC and MAC were still using AFM 66-1 as they had been since it came out in the late fifties. As we have seen, however, TAC had been on a roller coaster ride, in and out of AFM 66-1 during the entire decade of the seventies. The rather ominous and terse first paragraph of the new AFR 66-5 may reveal some of the frustrations of trying so desperately to design an organization that fit TAC's requirements and the fact that they wanted it to stay that way. The first paragraph read:

1-1. Objective of This Regulation. The objective is to give authority and flexibility to maintenance managers to perform their assigned responsibilities. To assure this authority is not eroded, MAJCOM and USAF personnel must not apply personal interpretations or judgement calls to areas left specifically broad in this regulation.³⁹

Two particular ironies can be pointed out concerning the advent of POMD. After almost 30 years of perfecting a specialized maintenance concept, the idea of CUT training specialists was at least a token return to the generalist concept of maintenance. Second, with the publication of AFR 66-5, the Air Force was formally recognizing a second and totally different maintenance organizational structure. The irony is that one of the stated reasons for adopting AFM 66-1 was standardization.⁴⁰ These ironies just point out how the Air Force had matured as a service since 1947 and had allowed logical changes to be made to enhance readiness. The temptation to continue the status quo must have been very seductive to some hide bound traditionalists.

One major concern at the outset of POMO was that the specialists would be at a disadvantage on their Specialty Knowledge Test (SKT) scores which were used as a major consideration for promotion. It was felt that they may be at a disadvantage to those people in AFM 66-1 organizations since POMO specialists in AGS never got to do any shop work and those in EMS and CRS rarely got on the flight line. Their counterparts in AFM 66-1 organizations did both. However, the fears proved unfounded as a study by the Air Force Manpower and Personnel Center indicated that SKT tests were virtually the same for both groups.⁴¹

In summary, as the Air Force entered the eighties, two maintenance organizational structures had evolved to support the particular needs of the three MAJCOMs. The situation would remain basically stable until 1987.

CHAPTER III

WHERE WE ARE

TAC's move to POMO set the stage for the Air Force wide maintenance organizational structure we see today. Before examining the concepts used by the three MAJCOMs, it is necessary to look at what regulatory guidance is provided by HQ USAF.

The basic regulation that outlines maintenance program policies and assigns responsibilities is AFR 66-14, The US Air Force Equipment Maintenance Program. It defines two categories of maintenance; on-equipment and off-equipment; and three levels of maintenance; organizational, intermediate and depot. On-equipment maintenance is performed at the organizational level and off-equipment maintenance is performed at the intermediate level. Depot level does both. This guidance is simple and general in nature, but provides the framework for developing a suitable organizational structure at wing level.

The other regulation providing guidance is AFR 66-1, Maintenance Management System. It implements the provisions of AFR 66-14 and establishes the maintenance management system. The key element of this regulation is that it delegates to the MAJCOMs the authority to organize maintenance activities under either the centralized or decentralized functional concepts. MAJCOMs are not only

authorized, but encouraged to tailor the maintenance organizational structure based on the command mission. This guidance came out in 1983 and represented a dramatic change in philosophy from the 1972 concept of a standard organizational structure Air Force wide. Each MAJCOM has taken full advantage of the flexibility allowed by AFR 66-1 to organize to suit their particular mission.

Military Airlift Command (MAC)

MAC has been the most consistent of the MAJCOMs in terms of maintenance organizational structure, having had the same concept since the original AFM 66-1 was published in 1958. MAC is committed to the centralized maintenance concept because it best meets the mission needs of both strategic (C-5, C-141) and tactical (C-130) airlift. Its implementing directive is MAC Regulation 66-1, Maintenance Management Policy.

MAC Regulation 66-1 is virtually identical to the pre-1983 version of AFR 66-1. It consists of four volumes which spell out in detail the responsibilities of performing maintenance activities. The management system is based on a specialized maintenance concept and "is intended to provide the management procedures needed to ensure the most effective use of assigned personnel within their occupational specialty."¹

All aircraft maintenance functions in the wing are under the direction and control of the Deputy Commander for

Maintenance(DCM) and centrally controlled by the primary maintenance staff function, maintenance control. Personnel are organized in three maintenance squadrons; OMS, FMS and AMS. The DCM and his/her staff are responsible for planning, coordinating and controlling all maintenance activity. The three production squadrons are responsible for actually performing the maintenance. OMS performs only on-equipment maintenance and has only AFG personnel assigned. FMS and AMS perform both on and off-equipment maintenance and have only specialists assigned. The guidance and direction for efficient use of personnel comes from maintenance control.

The centralized concept has been and is effective in MAC because the MAC airlift mission is not sortie intensive. Departure reliability and scheduling effectiveness are the measures of merit. The strategic airlift units do not deploy during wartime. They operate out of home station and, in effect, are doing their wartime mission every day. The tactical airlift units normally deploy as a wing and the entire aircraft maintenance organization is available at the beddown location. Grouping the specialists functionally in separate squadrons and controlling their activities centrally from maintenance control eliminates duplication of effort and makes the most efficient use of available manpower.

Tactical Air Forces (TAF)

The TAF includes TAC, USAFE, PACAF and Alaskan Air Command. Their maintenance organizational concept is based on the POMO concept initially implemented in TAC in 1977. When the Air Force revised AFR 66-1 in 1983 and delegated organizational responsibilities to the MAJCOMs, the TAF used the old AFR 66-5 as a basis to publish Multi Command Regulation (MCR) 66-5, Combat Oriented Maintenance Organization (COMO). Notice that the name changed from production oriented to combat oriented. COMO is virtually identically to POMO and is based on the decentralized maintenance concept.

Unlike MAC, the TAF requires high sortie rates from a large number of aircraft and needs to be capable of operating from remote locations. The key to the COMO concept is to organize people and equipment into direct and indirect sortie producing elements. Like a centralized maintenance organization, there is a DCM who has overall responsibility for all maintenance activity in the wing. The DCM has a staff and three maintenance squadrons, but there is where the similarity ends. On-equipment maintenance is performed by the direct sortie producing squadron, the Aircraft Generation Squadron (AGS). The AGS contains all the people, equipment and decision making authority to meet sortie production requirements. Specialists that do on-equipment are assigned to the AGS

instead of to separate specialist squadrons. The basic building block of the AGS is the Aircraft Maintenance Unit (AMU) which contains enough of each type skill to be self sufficient from an on-equipment maintenance standpoint. Each AMU is matched with a flying squadron and it supports only that squadron. Normally, a TAF wing will have three flying squadrons, therefore, the AGS would have three AMUs. This structure has the effect of decentralizing decision making authority for all activity such as scheduling, production workloads, and repair priorities to the lowest level. The DCM staff monitors and coordinates activity instead of directing and controlling it as in a centralized organization.

The indirect sortie producing elements are divided into two additional maintenance squadrons, the Equipment Maintenance Squadron (EMS), and the Component Repair Squadron (CRS). These functions do off-equipment maintenance and give AGS serviceable assets with which to produce sorties. Like in the original POMD concept, the specialists in AGS are trained in many crew chief duties to make best use of all available manpower.

TAF units deploy to war as squadrons and the maintenance structure allows each squadron to have its own maintenance support. "The intent is to align an AMU with a flying squadron and allow both elements to train together on a daily basis to develop a mission effective, combat ready

team."² POMO got the TAF off of the slippery slope and COMO is keeping it off.

Strategic Air Command (SAC)

Since the centralized, specialized maintenance concept had its origins in SAC, it may seem logical that SAC has never wavered from the classic AFM 66-1 organizational structure. But if TAC was the restless MAJCOM of the sixties and seventies in terms of challenging the appropriateness of the centralized maintenance concept, SAC has been the innovator of the eighties. For the past few years SAC has been experimenting with a decentralized maintenance organizational structure and the tests were so successful, SAC formally implemented the new concept command wide in January 1987. The implementing directive is SAC Regulation 66-14, Readiness Oriented Logistics System (ROLS) Maintenance Management General Policy, and Deputy Commander for Maintenance (DCM) Staff Activities. ROLS is similar to COMO and was obviously influenced by it, but many of the familiar trappings of the old AFM 66-1 structure are still visible.

"ROLS was initiated to meet increased operations sortie requirements by moving decision making authority and resources to the flight line."³ As with COMO, the key to ROLS is consolidating all on-equipment maintenance in one maintenance squadron to allow all direct sortie producing activities to be managed at the lowest level, the flight

line instead of maintenance control. There is still a DCM, DCM staff, and three maintenance squadrons (OMS, FMS and AMS). SAC also has a fourth maintenance squadron, Munitions Maintenance Squadron, but it was unaffected by the change to ROLS. OMS, FMS and AMS all retain their same name under ROLS, but OMS becomes solely responsible for on-equipment maintenance. Specialists from FMS and AMS have been permanently assigned to OMS in a specialist flight to give OMS full on-equipment capability. FMS and AMS primarily work off-equipment component repair.

This structure gives the OMS line chief the authority and responsibility for maintenance production, a function previously assigned to maintenance control. As a result, the Job Control function of Maintenance Control is renamed under ROLS as the Aircraft Readiness Center (ARC). The ARC is responsible for monitoring and coordinating maintenance activity, but does not direct production. That function has been decentralized to the flight line, therefore, ROLS is a decentralized maintenance concept.

SAC sees three primary benefits to be gained by ROLS. First, increased efficiency on the flight line with better teamwork and more resources on the flight line. Second, ROLS makes the most of noncommissioned officer (NCO) talent by moving decision making authority to the lowest level. Finally, since aircraft are fixed faster under the ROLS concept, sortie taskings are more easily handled.⁴ SAC

is committed to ROLS, and certainly the concept will undergo changes as more is learned, but it appears General LeMay's centralized maintenance concept is dead in SAC for the time being.

CHAPTER IV

WHAT'S THE FUTURE?

Through its first 40 years, the longest period of time the Air Force has gone without some major, systemic change to its maintenance organizational structure was the eight year period between 1958 when AFM 66-1 was mandatory Air Force wide and 1966 when TAC initiated the TAC Enhancement program. There is little reason to suspect that this evolutionary process will not continue.

It can be argued that the concepts of maintenance organizational structure have come full circle since World War II. Maintenance was totally decentralized then with crew chiefs in the operational flying squadrons managing and directing all maintenance on their particular aircraft. The pendulum swung slowly to a centralized concept which culminated in AFM 66-1 in 1958. With the TAF firmly entrenched in PDMG and SAC's recent conversion to ROLS, the majority of the Air Force has returned to the decentralized method.

It is interesting to note that part of the justification for every change in structure inevitably was the same two factors. They are 1) the need to produce more aircraft for operational use, and 2) the need to make the most efficient and effective use of available resources, both people and equipment. The real irony is that these

justifications were used regardless of the nature of the impending change. It didn't matter whether it involved going from centralized to decentralized or vice versa. Invariably, management indicators would improve shortly after the organizational change, thereby proving the wisdom of the new system. Is it possible that change itself, not the nature of the change produced positive results? So much of maintenance depends on the motivation and commitment of the individual mechanic, attributes that cannot be legislated. The quality of that motivation is more a product of effective leadership than an organizational structure. Future attempts to adjust organizational structure to compensate for poor production should consider that phenomenon. That is not to suggest that the organizational changes we have seen were unnecessary, but they must be kept in perspective.

The Air force has shown a great deal of maturity in delegating to the MAJCOMs the authority to design maintenance organizations best suited to their individual missions. As long as that option exists, MAJCOMs will continue to tinker with structure to enhance maintenance production. They will, however, be strongly influenced by three main factors.

The first of these factors is a new program the Air Force is developing nicknamed RIVET WORKFORCE. The objective of the program is to consolidate specialists

working in similar Air Force Specialty Codes (AFSC) into one combined AFSC. For example, currently there is an AFSC in the avionics maintenance area for a communications specialist and a separate AFSC for a navigation specialist. These jobs require virtually identical skills and lend themselves toward consolidation. The idea is that with increasing reliability of avionics equipment and increased capability of the airmen being recruited into today's Air Force, one person can be trained to do what used to be two jobs. The effects as a force multiplier are obvious. Just as obvious is the need to adjust the organizational structure of both centralized and decentralized organizations to compensate for what will be a significantly fewer number of specialists. If history has taught us anything, those organizational changes will vary from command to command.

A second major factor affecting possible maintenance organizational structure changes will be budgetary constraints. Just as during the post-WW II, post-Korea and post-Vietnam eras when consolidation and economy of force were management bywords, the current national struggle to control the national debt has already entered the Air Force into a cut-back mode. The problem will be more affected by cutbacks in spares funding, however, than by personnel cutbacks. Budget realities have already impacted programs to procure and repair spare parts. "For example, the repair

of aircraft spare parts could be deferred, resulting in increased cannibalization and reduced numbers of mission ready aircraft..."¹ Cannibalization, the process of removing parts from one aircraft to fix another, is a force de-multiplier. It doubles the workload and wears out the pool of spare parts faster. Any factor which increases workload will directly impact organizational structure. Remember, decentralized maintenance is based on having enough specialists to divide them organizationally between on- and off-equipment maintenance. A worst case scenario where spare parts availability causes increased workload through cannibalization, manpower cuts are implemented, and AFSCs are consolidated to conserve personnel would undoubtedly result in consolidation of maintenance resources in a centralized fashion.

The third factor is more long-term in nature but has the potential to produce dramatic change. That factor is R&M, the current buzz-acronym for reliability and maintainability. The idea is to stress R&M during the acquisition phase of an aircraft toward an end result of needing less maintenance support when it is fielded. The Air Force has demonstrated its seriousness about R&M in the Advanced Tactical Fighter (ATF) Program by making R&M goals the same priority as performance goals.

As a result, we anticipate the sustained sortie generation rate of the ATF to be at least twice that of the F-15, mobility requirements will be cut in half, and fewer maintenance personnel and less support equipment will be required."

Since maintenance organizational structure seems to be a function of the number of personnel required to do the maintenance mission and the nature of the mission; e.g. is it sortie intensive or departure reliability oriented; any development that significantly changes either of these factors may produce an organizational change.

The most important thing the Air Force needs to consider concerning future maintenance organizational concepts is to retain the flexibility of the past. The structures need to flow naturally from the requirements of the aircraft being supported. At this moment, the Air Force is organized the way it needs to be to support the existing aircraft. There is, however, nothing magic about centralized and decentralized maintenance, and 20 years from now they may be as obsolete as the crew chief system is today. We can only hope what is not obsolete, is the far sighted and open-minded thinking that today enables us to "Keep 'em flying!"

NOTES

CHAPTER 11 (Pages 4-24)

1. Supply and Maintenance, Army Air Force Regulation No. 65-1 (Washington: Headquarters, Army Air Forces, 13 August 1947), p. 2 (paragraph 2).
2. Lieutenant Colonel Thomas P. Foss et al., The Logistics Of Waging War, eds. Jane S. Allen and Lieutenant Colonel David C. Rutenberg, (Gunter Air Force Station, Alabama: Air Force Logistics Management Center, 1963) p. 100.
3. Captain James N. Townsend, USAF, A History Of Aircraft Maintenance In The Army Air Force And United States Air Force (Maxwell AFB, Ala.: Air Command and Staff College, 1978), p. 32.
4. Foss, p. 100.
5. Colonel Edmund J. Borowski, USAF, The Suitability Of The USAF Aircraft Maintenance System For Total War (Maxwell AFB, Ala.: Air War College, 1952) p. 47.
6. Captain George D. Benjamin, USAF, An Analysis Of Aircraft Maintenance Management Within Air Weather Service (Maxwell AFB, Ala.: Air Command and Staff College, 1965) p. 6.
7. Foss, p. 142.
8. Colonel Richard J. Fry, USAF, Aircraft Maintenance, A Limiting Factor In The Strategic Air Command (Maxwell AFB, Ala.: Air War College, 1957) p. 6.
9. "USAF Leaders Through The Years," Air Force Magazine, May 1987, p. 92.
10. Townsend, p. 28.
11. Borowski, p. 51.
12. Townsend, p. 34.
13. Fry, p. 8.
14. Maintenance--Engineering, Air Force Regulation 65-1 (Washington: Department of the Air Force, 30 December 1957), p. 1 (paragraph 2).

15. Ibid, p. 2 (paragraph 3).
16. Benjamin, p. 11.
17. Townsend, p. 38.
18. Foss, p. 151.
19. Benjamin, p. 12.
20. Ibid.
21. Depot, Field, and Organizational Maintenance, Air Force Regulation 66-1 (Washington: Department of the Air Force, 5 September 1961), p. 2 (paragraph 4).
22. Townsend, p. 41.
23. "USAF Personnel Strength--1907 Through 1988," Air Force Magazine, May 1987, p. 79.
24. Townsend, p. 42.
25. Foss, p. 160.
26. Squadron Leader Ronald G. Slaunwhite, "Squadron Maintenance," IAC Attack, August 1966, pp. 13.
27. Foss, p. 160.
28. "USAF Personnel Strength--1907 Through 1988," Air Force Magazine, May 1987, p. 79.
29. Captain William B. James, "New Look in Aircraft Maintenance Management," IAC Attack, March 1972, p. 29.
30. Maintenance Management, Air Force Manual 66-1 (Washington: Department of the Air Force, 1 August 1972), p. 1-1 (paragraph 1-3).
31. Ibid, Foreword.
32. Major General William R. Nelson, "POMC-A New Concept," Aerospace Safety, March 1977, p. 3.
33. Ibid.
34. Comments are based on author's notes from a briefing on POMC at the Deputy Commander for Maintenance Course conducted at the Center for Professional Development, Air University, Maxwell Air Force Base, Alabama, August 1986.

35. Nelson, p. 3.

36. David A. Anderton, "POMD and POST: keystones of TAC Readiness," Air Force Magazine, January 1979, p. 46.

37. Nelson, p. 4.

38. Foss, p. 182.

39. Production Oriented Maintenance Organization, Air Force Regulation 66-5 (Washington: Department of the Air Force, 17 October 1977) p. 1-1 (paragraph 1-2).

40. Townsend, p. 46.

41. Major Giberson, "Production Oriented Maintenance Organization (POMD) S&T Analysis," TIG Brief, May 12, 1979, p. 8.

CHAPTER III (Pages 25-32)

1. Maintenance Management Policy, MAC Regulation 66-1 (Scott AFB, Illinois: Headquarters Military Airlift Command, 22 July 1983), Volume 1, p. 2 (paragraph 1-5).

2. COMBAT ORIENTED MAINTENANCE ORGANIZATION, Multi-Command Regulation 66-5 (Washington: Department of the Air Force, 31 May 1985) p. 1-1 (paragraph 1-1a).

3. Captain Susan J. Voveris, "Readiness Oriented Logistics System (ROLS) In The Strategic Air Command," Copy of briefing script provided to author in January 1988. Captain Voveris is the ROLS Project Officer in HQ SAC/LGMM, Offutt AFB, Nebraska.

4. Ibid.

CHAPTER IV (pages 33-37)

1. United States Air Force, Air Force Issues Book (Washington: Department of the Air Force, Spring 1987), p. 6-5.

2. Ibid, p. 7-8.

BIBLIOGRAPHY

- Anderton, David A. "POMO and POST: keystones of TAC Readiness." Air Force Magazine, January 1979, pp. 46-50.
- Barrentine, Lieutenant Colonel Emmett S. Evolution Of The United States Air Force Organizational Maintenance System. Maxwell AFB, Ala: Air War College, 1967.
- Benjamin, Captain George D. An Analysis Of Aircraft Maintenance Management Within Air Weather Service. Maxwell AFB, Ala: Air Command And Staff College, 1965.
- Borowski, Colonel Edmund J. The Suitability Of The USAF Aircraft Maintenance System For Total War. Maxwell AFB, Ala: Air War College, 1952.
- Brown, Major Stanford E. Strategic Air Command: Increased Aircraft Utilization Through Improved Maintenance. Maxwell AFB, Ala: Air Command And Staff College, 1965.
- Chenzoff, Andrew P.; Beilstein, Karl R.; Shipton, David L.; Joyce, Reid P.; Campbell Wendy B.; and Weimer, Richard E. Analysis To Improve The Maintenance Environment: A View From Active Duty Aircraft Maintenance Personnel. Wright-Patterson AFB, Ohio: Air Force Human Resources Laboratory, 1984.
- Combat Oriented Maintenance Organization. Multi Command Regulation 66-5. Washington, D.C.: Department of the Air Force, 31 May 1985.
- Depot, Field, and Organizational Maintenance. Air Force Regulation 66-1. Washington, D.C.: Department of the Air Force, 5 September 1961.
- Equipment Maintenance Policies, Objectives, and Responsibilities. Air Force Regulation 66-1. Washington, D.C.: Department of the Air Force, 10 January 1969.
- Equipment Maintenance Policies, Objectives, and Responsibilities. Air Force Regulation 66-1. Washington, D.C.: Department of the Air Force, 8 October 1970.

Foss, Lieutenant Colonel Thomas P.; Hatcher, Lieutenant Colonel Thomas D.; Lipsey, Lieutenant Colonel James R.; Owen, Lieutenant Colonel Ronald H.; and Reynolds, Lieutenant Colonel James T. The Logistics of Waging War. Gunter Air Force Station, Ala: Air Force Logistics Management Center, 1983.

Fry, Colonel Richard J. Aircraft Maintenance, A Limiting Factor In The Strategic Air Command. Maxwell AFB, Ala: Air War College, 1957.

Giberson, Major Kenneth L. "Production Oriented Maintenance Organization (POMO) SKT Analysis." TIG Brief, May 18, 1979, p. 8.

James, Captain William B. "New Look in Aircraft Maintenance Management." TAC Attack, March 1972, pp. 28-29.

Maintenance--Engineering. Air Force Regulation 66-1. Washington, D.C.: Department of the Air Force, 30 December 1953.

Maintenance--Engineering. Air Force Regulation 66-1. Washington, D.C.: Department of the Air Force, 27 February 1956.

Maintenance Management. Air Force Manual 66-1. Washington, D.C.: Department of the Air Force, 1 September 1962.

Maintenance Management. Air Force Manual 66-1. Washington, D.C.: Department of the Air Force, 1 August 1972.

Maintenance Management. Air Force Manual 66-1. Washington, D.C.: Department of the Air Force, 1 May 1974.

Maintenance Management General Policy, And Deputy Commander For Maintenance (DCM) Staff Activities. Strategic Air Command Regulation 66-9, Volume I. Offutt AFB, Nebraska: Headquarters Strategic Air Command, 30 March 1984.

Maintenance Management Policy. Air Force Regulation 66-1, Volume 1. Washington, D.C.: Department of the Air Force, 2 January 1980.

Maintenance Management Policy. Air Force Regulation 66-1. Washington, D.C.: Department of the Air Force, 21 April 1983.

- Maintenance Management Policy. Military Airlift Command Regulation 66-1, Volume 1. Scott AFB, Illinois: Headquarters Military Airlift Command, 22 July 1983.
- Nelson, Major General William R. "POMO-A New Concept." Aerospace Safety, March 1977, pp. 2-4.
- Nettles, Lieutenant Colonel Thomas C. "Project RELOOK: The Case for Base Self-Sufficiency." Air Force Journal of Logistics, Fall 1987, pp. 4-7.
- Parker, John. "66-1 Maintenance System Spreads Knowledge." Air Force Times, November 20, 1963, p. 36.
- Production Oriented Maintenance Organization. Air Force Regulation 66-5. Washington, D.C.: Department of the Air Force, 17 October 1977.
- Production Oriented Maintenance Organization. Air Force Regulation 66-5. Washington, D.C.: Department of the Air Force, 15 July 1979.
- Readiness Oriented Logistics System (ROLS) Maintenance Management General Policy, And Deputy Commander For Maintenance (DCM) Staff Activities. Strategic Air Command Regulation 66-14, Volume I. Offutt AFB, Nebraska: Headquarters Strategic Air Command, 5 January 1987.
- Slaunwhite, Squadron Leader Ronald G. "Squadron Maintenance." TAC Attack, August 1966, pp. 12-13.
- Supply and Maintenance. Army Air Force Regulation 65-1. Washington, D.C.: Headquarters Army Air Forces, 13 August 1947.
- Taylor, Major Henry L. Road To Doctrine For SAC Aircraft Maintenance. Maxwell AFB, Ala: Air Command And Staff College, 1987.
- The US Air Force Equipment Maintenance Program. Air Force Regulation 66-14. Washington, D.C.: Department of the Air Force, 15 December 1986.
- Townsend, Captain James N. A History Of Aircraft Maintenance In The Army Air Force And United States Air Force. Maxwell AFB, Ala: Air Command And Staff College, 1978.
- United States Air Force. Air Force Issues Book. Washington, D.C.: Department of the Air Force, Spring 1987.

"USAF Leaders Through The Years." Air Force Magazine,
May 1987, p. 92.

"USAF Personnel Strength--1907 Through 1988." Air Force Magazine, May 1987, p. 92.

Voveris, Captain Susan J. "Readiness Oriented Logistics System (ROLS) In The Strategic Air Command."
Briefing Script, Offutt AFB, Nebraska: Headquarters Strategic Air Command/LGMM, 1987.